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Parasitoids of *Liriomyza sativa* in Farmer Fields in the Batticaloa District

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ABSTRACT. *At present leafminers of the genus Liriomyza are a group of the serious insect pests of a number of vegetable crops and ornamental plants in the Batticaloa district of Sri Lanka. The control of Liriomyza is difficult because they are polyphagous, have the ability to develop resistance to several groups of insecticides and their natural enemies are eliminated by over use and misuse of insecticides. Hence, a study of the parasitoids of leaf miners would help to develop suitable environmentally friendly management procedures.*

Four hundred and fifty farmer fields were randomly selected from 17 Agricultural Instructor divisions in the Batticaloa district for this survey. Using destructive sampling, leaves of vegetables and wild plants showing Liriomyza leafminer damage were collected from selected farmer fields. After confirming that the dead host larvae were parasitized, collected leaves were kept separately in aerated plastic vials until the emergence of adult parasitoids. Adult parasitoids that emerged were identified with the help of reference collections and taxonomic catalogues.

Four hymenopteran parasitoids of Liriomyza sativa namely, Pnigalio katanosis Ishii (Family Eulophidae), Opius spp. (Family Braconidae), Neochrysochalis okazakii Kamijo (Family Eulophidae) and Diglyphus iseae Walker (Family Eulophidae) were detected. Among them, Diglyphus iseae Walker was the most abundant parasitoid of Liriomyza leafminers in the district. It had a parasitism level of 58.71% among the four species (Neochrysochalis okazakii Kamijo 23.74%, Opius spp. 12.26% and Pnigalio katanosis 5.29%).

INTRODUCTION

Liriomyza spp. was not considered as pests of crops in Sri Lanka until 1980. The first incidence of *Liriomyza* spp. was recorded in 1993 from mid country and was identified as *Liriomyza trifolii* (Wijesekara, 1997). Another new species was reported from upcountry in 1997, and this species was identified as *Liriomyza huidobrensis* (Wijesekara, 1997). Both species were reported to be accidentally introduced into Sri Lanka.

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The control of leafminers only by insecticide is very difficult. However, an integrated pest management program would successfully control leafminer populations. The main control tactic of this program is the conservation of its natural enemies (Parrella, 1987).

At present leafminers of the genus *Liriomyza* are a serious group of insect pests in the Batticaloa district of Sri Lanka attacking a wide range of vegetable crops and ornamental plants. The control of *Liriomyza* is difficult because they are polyphagous and have the ability to develop resistance to several groups of insecticides mainly due to the elimination of natural enemies by abuse and misuse of insecticides (Ravindra *et al.*, 2001). Therefore, a study on parasitoids of leaf miners would help to develop suitable management procedures that are environmentally friendly.

MATERIALS AND METHODS

Preliminary data on parasitoids of leafminers were collected by surveying farmer fields through observations of selected farmer fields and by laboratory studies. Farmers from nine Agricultural Instructor (AI) Divisions were selected for the survey, from among the 17 Agricultural Instructor Divisions in the Batticaloa district. The selected Agricultural Instructor Divisions were; Kaluwanchikudy, Karadiyan Aru, Mandur, Palugamam, Ayithiyamalai, Mandapathady, Vantharumoolai, Kiran and Arayampathy. Five Grama Niladhari (GN) Divisions were randomly selected from each of the selected AI division. From each GN division, ten farmer fields were selected for the study.

Collection of samples

One square meter of field was selected from each farmer field for the study. Within the area, all infected leaves with dead larvae of leafminers were picked. Samples were collected at weekly interval for one month and replicated four times.

The collected leaf samples of different vegetables crops and infested wild plants were taken to the laboratory and dead larval stages inside the leafmines were observed under a microscope, to confirm the presence of parasitic larvae or pupae inside the dead leafminer larvae. Leaves infested by *Liriomyza* and containing parasitic larvae or pupae were kept separately in aerated plastic vials until emergence of adult parasitoids.

The petioles of infested leaves were wrapped with moistened cotton wool to prevent wilting of leaves and to keep the parasitic larvae alive.

Identification of parasitic species

Characteristics of each adult parasitoids were recorded and were identified with the help of reference collections and taxonomic catalogues.

RESULTS AND DISCUSSION

Seven hundred and seventy five adult parasitoids belonging to the order Hymenoptera were collected from leaves infested with *Liriomyza sativa* during the experiment. The morphological, morphometric and bionomic descriptions of each parasitoid recorded during the study are given below.

Parasitoid species 1

This parasitoid was collected from infested leaves of tomato. It was observed that this species parasitizes only the third larval instar of *Liriomyza sativae.* The compound eyes and thorax of the larvae are black. The abdomen is light brown in colour. Three branches arise from first three annuli of the antennal flagellum. The wing venation is reduced. Jugal lobe of hind wing is absent. Hind wings are smaller than fore wings. The length and highest width of fore and hind wings were 0.75 mm, 0.25 mm and 0.72 mm, 0.125 mm respectively. There are nine hooks in the hamuli of hind wing.

Legs are light brown in colour with dark markings on the last tarsal segment and pre-tarsus of the hind femur. Trochanter is situated outside in between coxae and femur. Tarsal formula is 4 - 4 - 4. There are two claws in pre-tarsi. The length of the gaster is 0.3 mm. Based on these characteristics the parasitoid shown in Figure 1 was identified as *Pnigalio katanosis* Ishi belonging to the Family Eulophidae (Ferriere, 1931).

Parasitoid species 2

It was collected from leaves of all nineteen-host plants of *Liriomyza sativae* found in the Batticaloa district. The compound eyes, thorax and abdomen are light brown in colour. Antennae are filiform with 13 segments. The length and width of fore and hind wings are 0.3, 0.12 mm and 0.15, 0.03 mm respectively. Costal cell is absent. The legs are light brown. Tarsal formula was 4 - 4 - 4. Trochanter was outside between the coxae and femur. Pretarsus consists of two claws. The length of the gaster is 0.2 mm. This species shown in Figure 2 was identified as *Opius* spp. belonging to the Family Braconidae and Subfamily Opiinae (Achterberg, 1976).

Parasitoid species 3

It parasitized the larval stages of *Liriomyza sativae* in all the nineteen-host plants. The adult is metallic green in colour, mainly compound eyes, thorax and abdomen. Antennae are geniculate. Flagellum of antennae possesses six annuli. The length and width of fore and hind wings are 0.7, 0.25 mm and 0.4, 0.11 mm respectively. Venation was reduced. Legs are yellowish in colour. Tarsal formula is 4 - 4 - 4 and two claws are found in pretarsus. Trochanter is found outside between coxae and femur. The length of the gaster is 0.5 mm. This parasitoid shown in Figure 3 was identified as *Neochrysochalis okazakii* Kamijo belonging to the Family Eulophidae (Minkenberg and van Lenteren, 1986).

Parasitoid species 4

This was collected from all 19-host plants of *Liriomyza sativae* in the Batticaloa district. The abdomen, thorax and compound eyes of this parasitoid are black. Antennae are geniculate with five annuli in the flagellum. The length and width of fore and hind wings are 0.6, 0.25 mm and 0.3, 0.09 mm respectively. Wing venation is reduced.

The yellow coloured legs have black markings on femur, tibia, last tarsal segment and pre-tarsi. The tarsal formula is 4 - 4 - 4. First tarsomer of the tarsi is larger than the other tarsomers. There are two claws in the pre-tarsi. The length of the gaster is 0.4 mm.

Based on these characters the parasitoid shown in Figure 4 was identified as *Diglyphus iseae* Walker belonging to the Family Eulophidae (Minkenberg and van Lenteren, 1986).

Table 1 gives the number of each parasitoid species that was collected during the study and the host larval instar that was parasitized by each parasitoid species.

Table 1. Proportion of each parasitoid species among the adult parasitoids that were collected (n = 775) and the host stage parasitized.

	Parasitoid species			
	Pnigalio katanosis	***Opius* spp.**	***Neochrysochalis okazakii* Kamijo**	***Diglyphus iseae***
Number of parasitoids collected	41 (5.29%)	95 (12.26%)	184 (23.74%)	455 (58.71%)
Host larval instar Parasitized	3rd instar	2nd and 3rd instars	2nd and 3rd instars	2nd and 3rd instars

D. iseae was the most abundant parasitoid of *L. sativae* in Batticaloa district. It had a parasitism level of 58.71%. A suitable inexpensive method for mass culturing of *D. isaea* must be evaluated for the augmentation of this efficient parasitoid in the field.

The potential of these parasitoids has been demonstrated by many scientists in America, Asia and Africa. Minkenberg and van Lanteren in 1986 found that, *Diglyphus* spp. and *Chrysocharis parksi* are generally the most important parasitoids of leafminers in North America.

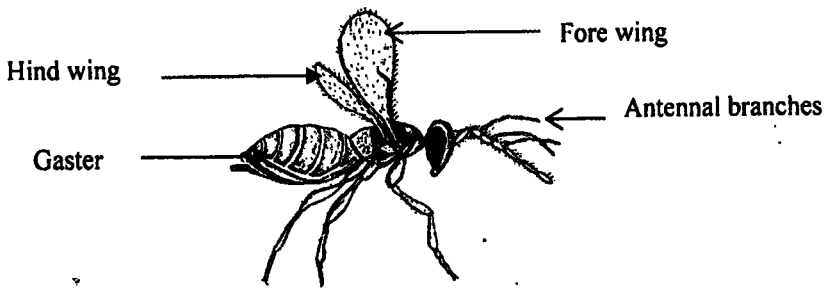

Fig. 1. Adult, *Pnigalio katanosis* Ishi (x 80)

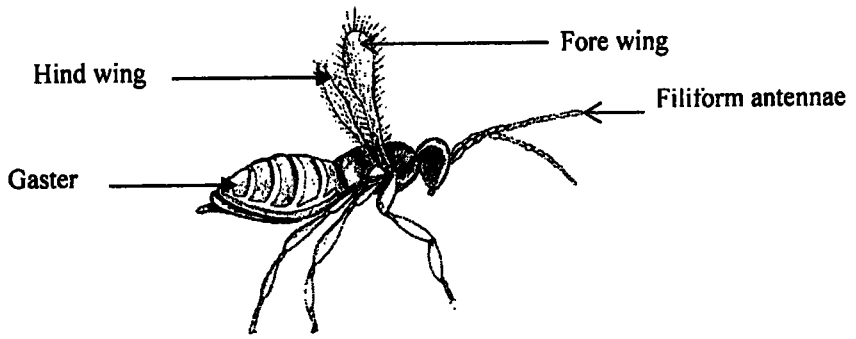

Fig. 2. Adult *Opius* spp. (x 160)

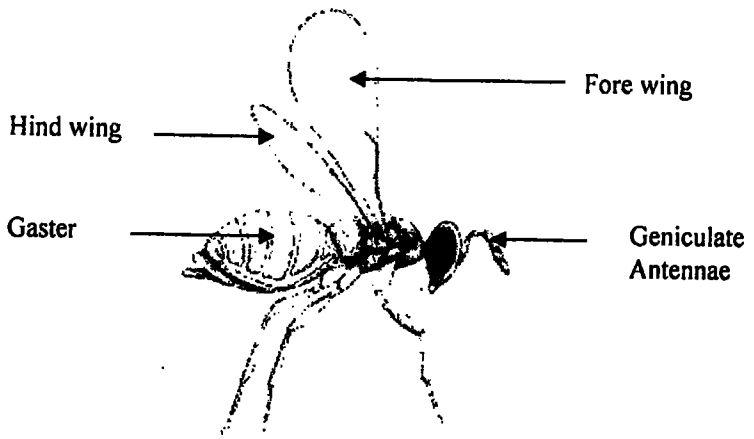

Fig. 3. Adult, *Neochrysochalis okazakii* kamijo (x 120)

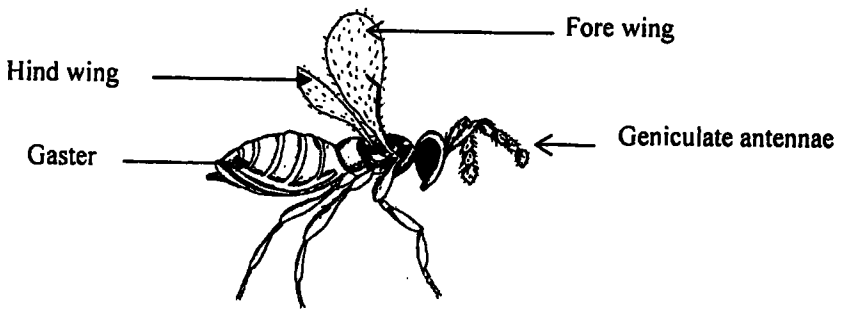

Fig. 4. Adult, *Diglyphus iseae* Walker (x 160)

No egg parasitoids of *Liriomyza* were found during the study. All four species of parasitoids collected were larval parasitoids of *Liriomyza sativae* found inside the leafmines. They had a long ovipositor so as to penetrate the upper epidermal cell of the leaf and exoskeleton of the *Liriomyza* larvae.

These four species of parasitoids are included in the list of natural enemies of *L. sativae* by Waterhouse and Norris (1987). Except *P. katanosis*, the other three parasitoids were collected from *L. sativae* infesting all nineteen-host plants. It appears that, no specific phytochemicals are involved in host selection of host by the parasitoids. However, the characteristics of tomato leaves may have influenced the host selection of *P. katanosis*.

CONCLUSIONS

Four parasitoid species of *L. sativae* were recorded from the Batticaloa district of Sri Lanka. Among them *D. isaea* is found to be the most abandant species that controls *Liriomyza* leafminer populations. The four species of parasitiods are likely to have a role in the management of *Liriomyza* programmes in the future.

This study shows that these parasitoids have a potential in suppressing *Liriomyza* leafminers in the Batticoloa district. Therefore a study on the bionomics of these parasitoids is essential for mass multiplication to manage the problems of *Liriomyza* leafminer damage.

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